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Digital transformation and organizational knowledge: A systematic literature review

A transformação digital e o conhecimento organizacional: Uma revisão sistemática da literatura

Transformación digital y conocimiento organizacional: Una revisión sistemática de la literatura

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ABSTRACT

Literature has pointed out that Digital Transformation (DT) is imposing a complete organizational change on companies. However, there is still a limited understanding of the changes related to knowledge and its processes in this scenario. Therefore, the objective was to verify how the field of study of knowledge management is developing in light of the changes caused by DT. The study used three databases to collect articles, and the data were analyzed with VOSviewer and content analysis. The results indicate that companies must develop new resources and capabilities (common and dynamic) to take advantage of DT opportunities. The study contributes to a better understanding of knowledge as a strategic resource in DT.

Keywords: digital transformation; digital technologies; knowledge; knowledge management; strategic resource.

RESUMO

A literatura tem apontado que a Transformação Digital (TD) está impondo às empresas uma completa mudança organizacional. Contudo, ainda há um entendimento limitado sobre as mudanças relativas ao conhecimento e seus processos nesse cenário. Diante disso, o objetivo foi verificar como o campo de estudo de Gestão do Conhecimento está se desenvolvendo diante das mudanças ocasionadas pela TD. O estudo utilizou três bases de dados para a coleta de artigos, sendo os dados analisados com o *VOSviewer®* e análise de conteúdo. Os resultados indicam que as empresas devem desenvolver novos recursos e capacidades (comuns e dinâmicas) para aproveitar as oportunidades da TD. O estudo contribui para melhor compreensão sobre o conhecimento como um recurso estratégico na TD.

Palavras-chave: transformação digital; tecnologias digitais; conhecimento; gestão do conhecimento; recurso estratégico.

RESUMEN

La literatura ha señalado que la Transformación Digital (TD) está imponiendo un cambio organizativo completo a las empresas. Sin embargo, aún existe una comprensión limitada de los cambios relacionados con el conocimiento y sus procesos en este escenario. Por tanto, el objetivo era comprobar cómo se está desarrollando el campo de estudio de la gestión del conocimiento ante los cambios provocados por la TD. El estudio utilizó tres bases de datos para recopilar artículos y los datos se analizaron con VOSviewer y análisis de contenido. Los resultados indican que las empresas deben desarrollar nuevos recursos y capacidades (comunes y dinámicas) para aprovechar las oportunidades de TD. El estudio contribuye a una mejor comprensión del conocimiento como recurso estratégico en TD.

Palabras clave: transformación digital; tecnologías digitales; conocimiento; gestión del conocimiento; recurso estratégico.

1 INTRODUCTION

Digital Transformation (DT) can be considered as one of the main challenges faced by companies during the last years (Saarikko, Westergren & Blomquist, 2020). Due to its strategic relevance (Singh, Klarner & Hess, 2020) it has been evidenced that DT challenges managers in different contexts and sectors (Saarikko, Westergren & Blomquist, 2020). DT challenges companies by requiring from them, in addition to mastering smart and digital technologies, the ability to reflect on their purposes, demonstrating that DT is not only related to technology, but is a phenomenon linked to organizational changes caused and outlined by diffusion of digital technologies (Hanelt, Bohnsack, Marz & Antunes, 2020).

It has been argued that DT changes organizational processes and structure, in addition to affecting the interactions between different stakeholders of a company (Mizintseva & Gerbina, 2017; Fischer, Imgrund, Janiesch & Winkelmann, 2020 , as with the intensive use of digital technologies, companies experience new ways to seek knowledge, make decisions, generate data, make partnerships and develop their strategies. In the realm of knowledge, this becomes even more intense, given that knowledge is a unique resource for the competitiveness of companies (Nonaka & Teece; 2001). Lazolla, Pesce and Tucci (2020) stated that digitization, the basis for DT, has shown a deep impact on the search and recombination of knowledge. Due to digital technologies, companies are more susceptible to opening the innovation process, which generates access to new external knowledge (Cui, Wu & Tong, 2017). This will require companies to make additional efforts to explore and apply knowledge, whether it is new or existing. There is also evidence that the knowledge transfer process will depend less on interpersonal relationships, given the advancement of digital technologies (Boeker, Howard, Basu & Sahaym, 2019).

However, there is still no clear understanding of organizational knowledge and its management in the context of DT and its implications on companies (Hausberg et al., 2020). The importance of addressing this issue lies in the current need for companies to rethink the ways in which they can effectively explore and manage knowledge to achieve benefits. As highlighted by Hanelt et al., (2020), the phenomenon of DT differs from other changes already experienced by companies, such as IT-related changes, thus it cannot be explained in its entirety using the consolidated theoretical models (Hanelt et al., 2020). Hausberg et al. (2019) highlighted the need for more studies on knowledge management, considering the complexity and importance of the field in the digital age. In this same line, Alvarenga, Matos, Godina & Matias (2020) also emphasized the importance of systematized literature studies relating DT and Knowledge Management (KM). Therefore, given the research gaps presented, this study analyses the literature on Digital Transformation and organizational knowledge

aiming to understand the critical factors for companies to explore and manage knowledge in DT and its implications for the field of study.

The study is based on a systematic literature review. Three databases were used: Scopus, Web of Science (WoS) and Science Direct for the collection of articles. From the inclusion and exclusion criteria, 38 articles were selected for two types of analysis: a descriptive and a cluster analysis, using the VOSviewer® tool.

In addition to this introduction, the paper is divided into five sections. First, Digital Transformation and Organizational Knowledge is discussed. Then, the methodological procedures of the study are presented, highlighting the research protocol adopted in the study. The next section deals with the results of the study analyses. The fifth section presents the discussions and agenda for future studies. Lastly, the final considerations of the study are presented, as well as the bibliographical references used.

2 DIGITAL TRANSFORMATION (DT) AND ORGANIZACIONAL KNOWLEDGE

The emergence of the DT paradigm is related to the rise of technologies that have enabled the constant interaction between objects and people and admitted a new way of generating and processing data (Rindfleisch, O'hern & Sachdev, 2017; Schneider & Kokshagina , 2020). Big data, the internet of things (IoT), cloud computing and other technologies are often associated with Industry 4.0, the Digital Industrial Revolution and the Digital Economy (Witkowski, 2017). However, although the term "Digital Transformation" (DT) permeates the modern world, there is still no established definition for the concept (Hausberg et al., 2019). In this matter, DT does not refer only to technological changes, but also to the consequences that these changes cause in companies (Hausberg et al., 2019). This causes a transformation of core business processes, as well as organizational structures and the very concepts of management (Fischer et al., 2020). In this same direction, Rogers (2017) indicates that DT is not just technology, but also a change in the way of doing business strategy. Therefore, there are indications that the changes from DT will alter societies and industries comprehensively (Fischer et al, 2020). In summary, DT provides three significant changes in business: (i) processes with digital support; (ii) digital communication and (iii) new ways of creating value based on digitally obtained innovations or data (Hausberg et al., 2019).

For some companies, organizational changes resulting from DT can be transformative or disruptive and what will define the result, therefore, is the company's ability to harness the potential of digital technologies, such as big data, internet of things (IoT), artificial intelligence, blockchain and others (Saarikko et al., 2020). As highlighted by Hausberg et al. (2019), several of the technologies that influence DT are not novelty. What is new is the way these

technologies are combined and used. Thus, the management of DT and its effects on companies is relevant as it can even remove a company from its competitive position, leverage its operational efficiency, create entirely new markets or even improve its performance, among others (Saarikko et al., 2020).

Studies on DT have shown positive results of digital technologies in business (Hausberg et al. (2019). However, there is also evidence that shows that DT will affect the entire society, causing, for example, an increase in unemployment (Frey & Osbone, 2013). Regarding the positive results of DT, there is an increase in sales and productivity pushed by new forms of collaboration between customers and suppliers (Parviainen, Tihinen, Kääriäinen & Teppola, 2017); increasing in value creation (Stock & Seliger 2016); better performance and productivity (Saarikko et al., 2020); among others.

All the potential arising from DT therefore will only happen if companies are willing to adapt their strategies and develop capabilities to realize, create and appropriate value, which involve technological and managerial capabilities. The capabilities of a company can be classified as common or dynamic (Teece, 2014). Common capabilities are those that enable companies to perform efficiently in business functions such as management and operations (Teece, 2012, 2014). In contrast, dynamic capabilities are those of a higher order that transform a company's resource base (Winter, 2003). They define the speed and extent to which companies' resources can be recombined to meet the opportunities and demands of the changing environment (Teece, 2014). The dynamic capabilities perspective acts as a bridge between the organization's internal resources and the dynamic business environment. Dynamic capabilities support organizations to improve their resource base, through a continuous process, providing possible sustainable competitive advantage (Teece, 2014).

In this context, knowledge is highlighted as a key asset as it creates the core company competence that is the competence responsible for generating differentiation over competitors (Al-Dmour, Al-Dmour & Rababeh, 2020). The first academic discussions about this phenomenon occurred around the concept of Knowledge Management (KM) (Nonaka & Takeuchi, 1995) which represents the processes and practices conducted in a company in order to foster its intellectual potential, increasing the efficiency of knowledge management (Gold, Malhotra & Segard, 2001). It demonstrates that any company seeking to be successful in the digital economy must have a deep understanding and an effective system to manage knowledge reserves (Mizintseva & Gerbina, 2017).

The DT process has a relevant effect on KM practices and this can be considered a critical factor for the success of DT (Alvarenga et al., 2020). However, it should be noted that due to changes in the digital economy, many of the knowledge processes are changing significantly (Boeker et al., 2019). For instance, given the reach of digital technologies, knowledge transfer will depend less on interpersonal relationships. Information systems enabled agile communication and collaboration between groups, facilitating the connection between individuals in the production of quality knowledge (Boeker et al. 2019). On the other hand, some studies indicate that digital technologies, by creating new connections between individuals and groups, can also generate high levels of knowledge complexity (Lazolla et al., 2020) which can compromise company results. In this thinking, Mabey and Zhao (2017) found that the more widespread the technologies for knowledge exchange, the more the knowledge becomes tacitly isolated in certain groups and the more difficult it is to convert it to explicit form.

Despite the literature's ambiguity regarding knowledge and digitization (Lazolla et al., 2020), KM was recognized as a capable tool of helping companies in DT process accelerating them (Alvarenga et al., 2020; Mizintseva & Gerbina, 2017). Boeker et al. (2019) evidenced KM as essential for synergy creation between the technological capabilities and managerial practices of companies in the tourism sector. Alvarenga et al. (2020) also found them as critical success factor for DT in public sector organizations. Digitization and DT together have provided greater fluidity to organizations as well as to their processes. However, it also requires new ways of companies in exploring and managing knowledge flows (Castagna et al., 2020). KM seems to be crucial in DT, helping companies to identify knowledge gaps and fill them, fostering innovation (Mizintseva & Gerbina, 2017). In this sense, it can be inferred that DT favours KM as it helps in knowledge management practices (acquisition, assimilation, dissemination and storage) and, on the other hand, KM has favoured the success of DT and both have gained relevance in the organizations' strategic positioning (Alvarenga et al., 2020).

3 METHODOLOGY

To investigate the research area on "digital transformation" and "knowledge" the SLR (Systematic Literature Review) methodology was adopted (Massaro, Dumay & Guthrie, 2016). SLR is a recommended method to examine a corpus of academic literature in order to gain insights, critical reflections, and generate new paths and research questions (Massaro et al., 2016). Therefore, the present research is structured in the following steps: (i) research questions definition; (ii) writing of research protocol; (iii) papers selection; (iv) development of a coding framework and (v) carry out a critical analysis and discussion, pointing out future paths and research.

3.1 Definition of research questions

The first step for implementing the SLR is the definition of three main research questions (Massaro et al., 2016), which in this research are:

Q1: How is the organizational knowledge (management) literature developing in line with the changes from DT?

Q2: How has organizational knowledge and its management been impacted by DT?

Q3: What are the implications of this DT research for companies' organizational knowledge?

Q1 intends to define the "state of the art" in the literature on the DT phenomenon and its impact on knowledge and its management. Q2 aims to understand, in a more focused way, the possible effects of DT on organizational knowledge processes. Q3 helps researchers to advance this debate through discussions about the relationship between DT and CG for companies.

3.2 Research Protocol

The research protocol - the second stage of the SLR requires the identification of information sources, methods and tools used to analyse the studies (Massaro et al., 2016). In this research, a perspective of dense analysis was adopted, investigating the most relevant articles in order to build a solid base. A longitudinal study was adopted, searching articles in the Scopus, Web of Science (WoS) and Science Direct databases, which were chosen due to they be considered broad bases in the coverage of articles (Waltman, 2016). The data was analysed through VOSviewer® software, a tool that enables the construction and visualization of bibliometric networks and clusters (Eck and Waltman, 2009). The co-occurrence technique (Eck & Waltman, 2009) and the bibliographic encampment technique (Kessler, 1963) were used.

3.3 Papers selection

Once the databases were selected, the third stage of the SLR began, which is the identification of articles for the review. The searches were conducted between May and June 2020 and were unrestricted as to publication dates. They should be in the English language. Advanced searches were carried out in the databases using the keywords: "Digital" or "Digital Economy" or "Digital Transformation" or "Digital Technologies" and "Knowledge Management" or "Knowledge Exploration" or "Knowledge Transfer" or "Knowledge Acquisition" or "Knowledge Based Vision" or "Knowledge Absorption". The studies were collected through titles containing previous keywords and adopting the Boolean operator (AND; OR) as a connection.

Initially 1,236 articles were found and 38 constituted the sample. In order to improve the search, filters were applied to the areas with the greatest similarity to the studied problem, therefore, articles from the areas of social sciences, business, management and information were selected; business and information (154 out of 1,236). The duplicate articles were removed (7 out of 154). Thus, 147 articles were selected for the analysis. After reading the abstract, keywords, introduction and results (when necessary), 109 articles were excluded for not dealing with digital transformation or digital technologies and knowledge in the context of for-profit companies. The excluded articles covered several topics such as digital libraries; literacy; public administration; academic knowledge, among others.

3.4 Coding framework

The fourth phase of the SLR involved the coding structure whose purpose is to define the elements to be analysed in the selected studies. Two types of analysis were carried out in the 38 articles: a descriptive and a cluster analysis. Descriptive analysis aims to demonstrate some characteristics of the researched field, such as the evolution of publications, distribution of articles within a specific period and country (Massaro et al., 2016). For this, the following analysis categories were selected: (i) Publication time; (ii) Identification of journals; (iii) Geographic distribution of articles; (iv) Research approach; and (v) Keywords used by the authors. To ensure the reliability of the results, the data were analysed through VOSviewer® software, using the co-occurrence technique (Eck & Waltman, 2009) which analyses the list of articles based on the authors' common keywords. As a unit of analysis, "author's keywords" and a limit to include an article with a minimum of one occurrence of a keyword were defined.

For the cluster analysis, the bibliographic coupling technique (Kessler, 1963) was applied also with the aid of the VOSviewer® software which allows evaluating the articles according to the number of references they share. According to Eck and Waltman (2009) this technique allows exploring the relationship between studies, through the references used, contributing to the analysis process. To operationalize this technique, "documents" were defined as the unit of analysis and as a limit, articles with at least one citation per document. From the generated clusters a content analysis was carried out, considering: (i) papers' goals; (ii) papers' results and conclusions; and (iii) future studies agenda from all articles. The particularities from each analysis were discussed and allowed the identification of two research areas that will be presented in the results section.

3.5 Critical analysis, discussion and future research

The last stage of the SLR was the analysis and discussion of selected papers, mapping possible paths for future research. At this stage, in order to understand the emerging research area as well as the research gaps, a content analysis was carried out in each cluster with the support of VOSviewer through bibliographic coupling analysis. The following section presents the evidence arising from the SLR.

4 RESULTS

This section presents the SLR results that were organized according to the research questions. First, a descriptive analysis is presented followed by the content analysis based on the identified clusters

4.1 Descriptive analysis

The first research question of this study was to define the literature "state of the art" on the DT phenomenon and the impact on knowledge and its management.

4.1.1 Evolution of publications

Figure 1 shows the evolution of publications from 1999 to 2020.
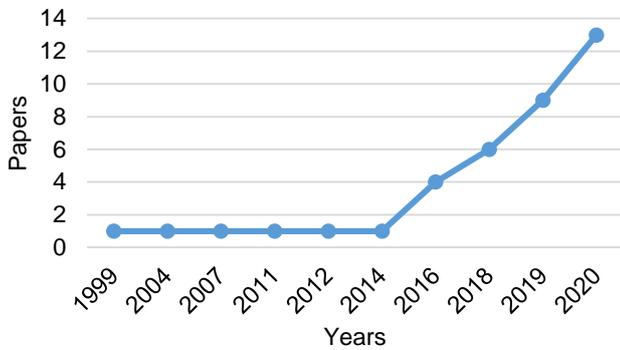
Figure 1. Evolution of publications over the years
Source: Elaborated by authors.

The first publication related to the topic was in 1999. Although this paper does not deal with the current DT, the study sheds light on the preponderant role of leadership in the networks era. In other words, after a case study, Kodama (1999) recommends new strategies to deal with the era of connectivity, such as new business styles, superior leadership capable of generating new skills and innovation. After this period, publications remained stable. As of the year 2014, the field has a rise in publications. In addition, more than half of the articles were published between 2019 and 2020, which demonstrates the subject's relevance and topicality, the need for future studies on DT and its relationship with knowledge.

4.1.2 Journals

The analysis of journals indicates a concentration of publication sources, as the articles in the sample were published in only 6 journals. The journal "Information and Management" has the largest number of publications (Table 1). The journal "International Journal of Information Management" is also highlighted as a pioneer in the subject, since of its 9 publications in the sample, 6 took place before the rise of the subject, in 2014.

Table 1
Distribution of the papers by journals

Journal	Number of papers
Information and Management	14
Journal of Business Research	12
International Journal of Information Management	9
Scientific and Technical Information Processing	1
Sustainability Switzerland	1
Vine Journal of Information and Knowledge Management Systems	1

Source: Elaborated by authors

4.1.3 Geographic Regions

Regarding the regions that produced most of the publications, there was a concentration of studies from Europe and Asia (Table 2). The countries that stood out in the regions were: United Kingdom (7) and China (4).

Table 2
Geographic regions

Regions	Number of papers
Africa	3
America	2
Asia	10
Europe	15
Oceania	1
Total	31

Source: Elaborated by authors.

4.1.4 Research Approach

The quantitative approach was the most used in the studies analysed, that was applied in 20 studies (Table 3). The most used data collection instrument was the questionnaire and structural equation modelling was the main means for data analysis, present in 15 articles.

The qualitative approach was also representative in the sample. Of the 14 articles that used this approach, almost all collected data through interviews and document research. The main form of analysis was content analysis, present in 13 articles. Few studies used mixed methods (qualitative and quantitative approaches) which may indicate research possibilities. It should be noted that review studies were not found in this sample.

Table 3
Research approach

Research approach	Number of papers
Mixed Methods	2
Qualitative Approach	14
Quantitative Approach	20
Theoretical Studies	2
Total	38

Source: Elaborated by authors.

4.1.5 Analysis of the authors' keywords

The keywords are very useful for authors, researchers and editors as they signal central themes in articles. The keywords were examined through the analysis of social networks and the results, supported by the use of VOSviewer®, showing seven clusters (Figure 2).

Figure 2 demonstrates the occurrences of different keywords in the papers and the relationship between them. The analysis reveals that digital innovation and business analysis capability are the most recurrent keywords (4 times), followed by survey (3), knowledge-based view (2), social media (2), organizational performance (2), capabilities (2), and business value (2). The results revealed that DT is associated with organizational capabilities and that it effects on business value and organizational performance. The knowledge-based view theory and the

survey tool were shown as useful to investigate the theme and, in addition, the results suggest that the research field is still under construction due to the wide variety of keywords used by actors to characterize the themes of research.

Figure 2. Groups of papers keywords
Source: VOSviewer.

4.2 Clusters and content analyses

From the understanding of the state of the art in the field, it was sought to understand possible effects of DT in organizational knowledge processes, as pointed out in research question two. Therefore, a content analysis was performed based on bibliographic coupling (Kessler, 1963), using all the articles in the sample and considering the works that share the same references. The results generated five clusters (Table 4; Figure 3), and this grouping was considered to minimize the results fragmentation from a specific area (Massaro et al., 2016).

As previously mentioned, to ensure the quality of the analyses, the content analysis of all articles was independently performed. The particularities arising from each analysis were also discussed which allowed the identification of two areas of research, summarizing the findings as follows:

(1) Research area 1: Critical resources for competitive advantage in the DT context.

(2) Research area 2: Organizational capabilities as enablers of competitive advantage in the DT context.

In this sense, the research areas are described and analysed here using content analysis.

Table 4
Bibliographic grouping of authors

Clusters	Authors
Cluster 1 (7 items - green)	Chi et al. (2018); Cui, Wu & Tong (2017); Castagna et al. (2020); Hensen & Dong (2019); Pilav-Veli´c & Marjanovic (2016); Muninger, Hammedi & Mahrc (2019); Zhang et al. (2020)
Cluster 2 (7 items - blue)	Aboelmaged (2014); Al-Dmour, Al-Dmour & Rababeh (2020); Shujahat et al. (2019); Ranganathana, Teo & Dhaliwal (2011); Torres & Sidorova (2019); Wong et al. (2019); Upadhyaya & Kumar (2020)
Cluster 3 (13 items - red)	Abrell (2015); Alberti-Alhtaybat et al. (2019); Barnes & Hinton (2007); David-West, Iheanachor & Kelikume (2018); Gupta & George (2016); Krishnamoorthi & Mathew (2018); Low & Johnston (2012); Merendino et al. (2018); Orlandi, Zardini & Rossignoli (2020); Côrte-Real,Ruivo & Oliveira (2020); Shamim et al. (2018); Zhang & Ravishankar (2019); Xu, Frankwick & Ramirez (2016)
Cluster 4 (2 items - yellow)	Fischer et al. (2020); Lokuge et al. (2018)
Cluster 5 (2 items - violet)	Braojos et al., (2020); Braojos, Benitez & Llorens (2018)

Source: Elaborated by authors using *VOSviewer*.

Figure 3. Bibliographic grouping of documents
Source: VOSviewer.

4.2.1 Research area 1

This research area represents a junction of clusters 2 and 3 (Table 4). It features a greater number of articles spanning the years 2007 to 2020. The area emphasizes tangible, intangible and human resources that will allow companies to develop capabilities to deal with the new digital economy and possibly achieve competitive advantage.

The literature has a wide classification of the types of resources. In this research, the investigated papers are mainly based on the definitions of Grant (2010); Bharadwaj (2000), and Santhanam and Hartono (2003), in which: tangible resources are understood as physical and financial resources that companies use in their operations; human resources include the experience, knowledge and wisdom of the individuals associated with a company and; Intangible resources include the attributes of a group of individuals associated with a company, involving organizational story, organizational learning, among others. Table 5 shows how these features are addressed in the articles.

Table 5
Definition of Resources

Resources	Definition of Resources
Tangible	Technology (Gupta & George, 2016; David-West et al., 2018; Aboelmaged, 2014; Wong et al., 2019). Data and its quality (Gupta & George, 2016; Shamim et al., 2018; Torres & Sidorova, 2019; Côrte-Real et al., 2020; Zhang & Ravishankar, 2019). Cloud services (Zhang & Ravishankar, 2019) *Blockchain* (Wong et al., 2019) Time and investments (Gupta & George, 2016) Flexible infrastructure and quality (Shamim et al., 2018; Torres & Sidorova, 2019) Technological, organizational and environmental structure (Aboelmaged, 201); Wong et al., 2019)
Intangible	Organizational learning and knowledge exchange (Gupta & George, 2016; Shamim et al., 2018; Al-Dmour et al., 2020) Contractual and relational governance (Shamim et al., 2018) Strategic planning (David-West et al. (2018) Culture (Alberti-Alhtaybat et al., 2019; Upadhyaya & Kumar, 2020) Customer and user knowledge (Abrell, 2015)
Human	Managerial and cognitive skills (Gupta & George, 2016; Merendino et al., 2018) Managers' leadership and strategy (Shamim et al., 2018; Xu et al., 2016; Low & Johnston, 2012; Merendino et al., 2018; Ranganathana et al., 2011) Collaboration between human resources (Shamim et al., 2018; Low & Johnston, 2012; Orlandi et al., 2020) Additional human capital (David-West et al., 2018; Barnes & Hinton, 2007; Krishnamoorthi & Mathew, 2018) Knowledge and performance (Ranganathana et al., 2011).

Source: Elaborated by authors using VOSviewer.

The Gupta and George's (2016) study is central to this area due to the scope of the article's connections with other ones (Figure 3) and the approach to tangible, intangible and human resources as well as the Shamim et al. (2018) and David-West et al.'s (2018) studies. Shamim et al. (2018) investigated the influence of big data management challenges, showing that companies demand several tangible and intangible resources. Similarly, David-West et al. (2018) also found the need for tangible, intangible and human resources for Nigeria's digital financial services providers.

Concerning tangible resources, some studies have emphasized their importance for digital innovation and companies' performance. Aboelmaged (2014) assessed that the readiness for technology and innovation were proportional to the technological infrastructure and capabilities of companies. Wong et al. (2019) analyzed that cost, competitive pressure and complexity can interfere with the intention to adopt blockchain in operations and supply chain management among Small and Medium Enterprises. Torres and Sidorova (2019) reinforce the importance of system quality, data quality and staff experience in big data analysis in the digital age. Corte-Real et al. (2020) also highlighted the importance of data quality in BDA and IoT capabilities, stating that data quality allows companies to expand and reshape their resource base. Zhang and Ravishankar (2019) indicate that the infrastructure for platform development, implementation, commercialization and improvement were crucial for the adoption of cloud computing.

Regarding to intangible resources, other group of studies emphasized their importance for digital innovation and company performance. Alberti-Alhtaybat et al. (2019) analyzed how a startup-minded business manages to make decisions quickly and has a flexible business model for value creation in DT. Another intangible resource pointed out as crucial for the success of companies in the digital economy was its culture. Upadhyaya and Kumar (2020) analyzed how this resource measures internal analytic knowledge, big data capacity and company performance. Al-Dmour et al. (2020) also addressed the impact of knowledge on digital innovation by validating and empirically examining the impact of KM functions on digital financial

innovation through the moderating role of the demographic characteristics of managers. Furthermore, Abrell (2015) found that both types of customer knowledge (explicit and tacit) assist in the long-term digital innovation of companies, so investing in this intangible asset is promising for companies.

Human resources were also highlighted with emphasis on the companies' innovation and competitiveness. Xu et al. (2016) postulated that companies that adopt a high level of traditional marketing analytics (TMA) and big data analytics (BDA) have higher levels of knowledge fusion and, consequently, product development success (NPS). Shujahat et al. (2019) analyzed the mediating role of knowledge worker productivity (employees who use ICT systems, Big Data) in the relationships between knowledge management processes and innovation. Low and Johnston (2012) highlighted the leadership and importance of staying at the forefront of emerging technologies for companies to create more vibrant and adaptive incrementalism behaviors, which, for them, is the role of leadership. Merendino et al. analyzed whether big data (BD) changed the decision-making process at the board level, showing that DB can vary according to the cognitive and dynamic capabilities of a company. Krishnamoorthi and Mathew (2018) concluded that changing a business involves human and technology assets combined.

4.2.2 Research area 2

The second search area represents a joining of clusters 1, 4 and 5 (Table 4). Studies in this area focus mainly on the role of organizational capabilities for innovation and knowledge processes (acquisition, exploitation, transfer) in the digital age. They highlighted the new digital technologies (social media, big data, IoT, cloud technology, digital platforms) encouraging companies to innovate in products, services and processes (Chi et al., 2018) by exchanging their knowledge with external agents. Consequently, this demanded organizational capabilities from companies to manage internal and external knowledge and thus respond to new market demands (Braojos et al., 2020). Table 6 shows how these capabilities are addressed in the articles as well as their respective effects.

Table 6
Capability definitions

Capabilities	Authors	Capabilities effects
Absorption capabilities	Pilav-Veli´c e Marjanovic (2016); Cui et al. (2017)	Promotes open innovation Affects value creation
Desorption capabilities	Braojos et al. (2020)	Improves performance
External KM capabilities	Braojos et al. (2020); Fischer et al. (2020)	Affects value creation Promotes innovation of business model
Internal KM capabilities	Hensen e Dong (2019)	Promotes internal innovation
IT integration capabilities	Braojos et al. (2020)	Improves performance
Collaborative innovation capabilities	Chi et al. (2018)	Improves capability of digital collaboration
Social media capabilities	Braojos et al. (2018); Zhang et al. (2020); Muninger et al. (2019)	Improves performance Promotes innovation

Source: Elaborated by authors using VOSviewer.

Pilav-Veli´ce Marjanovic (2016) found that companies that promote open innovation usually are more willing to process innovation, however, an intensive source of knowledge is not enough for innovation and, in addition, a high level of absorptive capability was necessary. Cui et al. (2017) aiming to understand the stages of the innovation process evidenced the influence of the absorptive capability enabled by IT affecting the performance of open innovation projects, which demonstrates the absorption of knowledge promoting open innovation.

On the other hand, Braojos et al. (2020) postulated that due to an opportunistic behavior, companies may be interested not only in the absorption of knowledge, but also in its disabsorption. Knowledge disabsorption refers to a process of transferring superficial/secondary knowledge from inside to outside the company. To check the validity of this theory, Braojos et al. (2020) analyzed how a company's IT integration capability affects the business's KM capabilities to create value. The results showed the ability of IT integration allowing the company to absorb and unabsorb knowledge with other organizations, which, in turn, improved the company's performance. Hock-Doepgena et al. (2021) also addressed KM capabilities in their studies by analysing the conditional effects of knowledge management capabilities on business model innovation in the context of SMEs. The results showed that external KM capabilities allow SMEs to innovate their business model.

Castagna et al. (2020) found digital technologies enabling Italian SMEs to operate in creative industries in their customer knowledge management strategies. They noticed that these SMEs adopted and made intensive use of traditional technologies for customer KM, despite the more profitable use of digital technologies demonstrating how this scenario is still disturbing for companies.

Hensen and Dong (2019) postulated that the company's internal use of IT to collect and share scientific or market knowledge influences the benefits of innovation at the process level and the performance of innovation at the organizational level. They verified the use of IT to search for knowledge positively influencing internal innovation. Chi et al. (2018) when analyzing how digital technologies help companies to reach collaborative innovation resources, they evidenced the capability of collaborative innovation improving another organizational capability: the capability of digital collaboration, that is, the capability of coordinating information between distributors on the internet. Fisher et al. (2020) analyzed digital transformation in different environmental settings and then recommend that companies carefully analyze their environment and determine their business needs in order to effectively address the technological, organizational, and operational requirements of DT. The authors provided a list of basic requirements for companies, such as process-oriented knowledge management.

Another research group investigated social media and innovation. Braojos et al. (2018) analyzed how IT resources affect company performance and evidenced IT resources, social media and e-commerce influencing individually and positively on company performance through online customer engagement. However, this result is conditioned on social media and e-commerce capabilities. Zhang et al. (2020) analyzed how social media-based customer co-creation influences business value in new product development and found social media-based customer-company co-creation indirectly affecting the performance of companies through their knowledge and development of dynamic capabilities. Muninger et al., (2019) also examined the use of social media in innovation processes and highlighted the need for strategic and operational resources, as well as the involvement of people from various departments and levels of the organization in acquiring and disseminating social media knowledge.

5 DISCUSSION AND FUTURE RESEACH AGENDA

This section aims to discuss the findings and present theoretical implications from the three research questions presented in section 3.1. Based on the answers to these questions, implications are proposed and presented in the following subsections.

5.1 Implication 1: How is the knowledge (management) literature developing in line with the changes brought about by DT?

In a more general literature review on DT, Hausberg et al. (2019) stated that knowledge management and DT research were still incipient. This may explain the rise of publications in the field, from 2014 onwards. Recent studies have shown that DT is still obscure and poorly understood by companies and academics (Fischer et al.; 2020). When observing the evolution of scientific articles that dealt with DT and knowledge in general, the growth of articles in the last years is evident. Another factor that can signal the expansion of the field are the keywords used by the actors to characterize the research themes. The wide variety of keywords evidences the exploratory interest of researchers in the subject.

Europe and Asia are the regions that have produced the most publications, especially the United Kingdom and China, which are countries with great expertise in the subject and, therefore, precursors in the theories regarding the subject. It is suggested that the innovation brought about by DT is awakening interest in advances in this field of research.

5.2 Implication 2: How has organizational knowledge and its management been impacted by DT?

These results show that DT occurs in many contexts and requires new strategies and behaviors for companies to manage their business. In this corporate restructuring,

tangible, intangible and human resources seem to play a central role. DT success stories have shown that companies will need tangible resources (eg data, technology, time, investments); human resources (management skills) intangible resources (culture, knowledge, organizational learning) to build capabilities and deal with DT. It should be noted that, by the DT paradigm, new resources were incorporated into the organizational reality. For example, data, which are mostly unstructured and require companies to have specific capabilities to deal with these resources.

Since most studies have shown the need for some organizational capability in managing the changes caused by DT, the importance of organizational capabilities in this process is also highlighted. This reinforces that DT is not just about technology, but rather a sociocultural process, as pointed out by Fischer et al. (2020) and knowledge, in this context, emerges as a unique asset, crucial for companies to renew and modify their resource base (Côrte-Real et al. 2016). Knowledge also showed itself capable of providing competitiveness and accelerating DT, when properly managed (Mizintseva & Gerbina, 2017). In an era with an abundance of information and data, the need for companies to understand how to acquire, absorb, transfer, explore and even unabsorb knowledge became evident. Therefore, it is postulated the need for dynamic capabilities for companies to deal with DT, considering that the possession of resources alone does not guarantee their competitiveness.

5.3 Implication 3: What are the implications of this DT research for the knowledge management of companies? Direction for future research

The analyses enabled the identification of promising research areas in the field of DT, digital technologies and organizational knowledge, outlining some possible paths for future research that are highlighted hereafter.

5.3.1 Agenda for research area 1

From the analysis, the importance of tangible, intangible and human resources in the development of organizational capabilities in the DT process in companies was identified (Gupta & George; 2016; Shamim et al., 2018; David-West et al., 2018). Understanding which resources and how they can help companies in the social DT process seems relevant. Concerning the resources, knowledge stands out, recognized as one of the most important resources in the digital age. Knowledge-based theory establishes that the proper use of knowledge provides companies with a sustainable competitive advantage (Al-Dmour et al., 2020). However, according to the theory, there must be structured processes for the acquisition, exploitation and transfer of knowledge. Therefore, competitiveness occurs through the application of knowledge and not through the possession of knowledge itself. Furthermore, it is the efficient management of knowledge that results in innovations. Therefore,

understanding the functions of knowledge (Boeker et al., 2019) can help companies implement more effective processes to deal with this new scenario. Institutional and economic issues as well as the company's life cycle are also highlighted (Fischer et al., 2020). These factors influence not only the resources available to companies, but also their funding strategies and growth objectives. Thus, a future research agenda in this area includes some research questions exemplified below:

Q1.1 How are knowledge functions (acquisition, exploitation and transfer) shaped by the advance of digital technologies? What roles should companies give back in this transformation contex?

Q1.2 How does the digital maturity of a company influence its knowledge processes? What are the implications on types of innovation?

Q1.3 How can cultural and economic differences and institutional pressures affect knowledge and its management in the context of DT?

Q1.4. To what extent does the quality of resources influence DT in companies?

5.3.2 Agenda for research area 2

Most of the analyzed studies showed that some organizational capability is needed to manage the changes caused by DT, and a large part of these capabilities are dynamic (i.e., capabilities that allow them gather new knowledge and apply it) (Hock-Doepgena et al., 2021), thus modifying the companies' resource base. These higher-order capabilities also reflect the complexity of the DT phenomenon and the use of innovative digital technologies by companies. As highlighted by Orlandi et al. (2020), digital technologies provided companies with a large amount of data, often disorganized and unstructured. For the authors, they must make sense of these data. In the same sense, Braojos et al. (2020) stated that when opening their innovation processes, companies must understand how to manage external knowledge, arising from collaboration, and incorporate it into the company. It is postulated that it is not enough for companies to develop operational capabilities, but dynamic capabilities are needed to reconfigure resources, especially knowledge. As highlighted by Winter (2003) and Teece (2014), dynamic capabilities are higher-order capabilities that lead companies to operate, extend, modify and create new capabilities. Therefore, to be successful with DT, companies should consider recommendations about their own resources beyond the capabilities needed to take advantage of DT opportunities and manage threats and changes in the environment (Tecee, 2014). Thus, a future agenda in this area includes some research questions, such as:

Q 2.1. How is knowledge quality affected by DT? What is its impact on company performance? What is the role of KM capabilities?

Q2.2 What is the role of knowledge absorption and disabsorption capabilities in the success of DT?

Q2.3 What is the role of collaboration (as an external source of knowledge) in building dynamic capabilities for the digital age?

6 CONCLUSION

DT has profoundly affected organizational processes, strategies and structures and, consequently, companies should rethink their resources and capabilities to deal with this reality. In terms of knowledge this is even more important, considering that this resource enables the construction of superior organizational capabilities. Therefore, this study analyzed the literature on DT and knowledge to investigate the field and seek implications for theory.

The debate on knowledge and DT has received increasing attention over the last six years and although the literature on knowledge and knowledge management is quite consolidated, the phenomenon of DT is new and still very diffuse in both academia and management, and the intersection of the themes is a promising field of study.

From cluster and content analysis, two central areas for academic debate were identified: a) critical resources for competitive advantage in the context of DT, and b) Organizational capabilities as enablers of competitive advantage in the context of DT. Most of the studies have shown that some organizational capability is needed to manage the changes caused by DT and that most of these capabilities are dynamic. This demonstrates that companies need to develop operational as well as dynamic capabilities to reconfigure resources, especially knowledge. Therefore, to succeed from DT, companies must consider strategically managing their own resources and having the necessary capabilities to seize the opportunities of DT. This study contributes mainly by providing greater understanding of the role of critical factors (resources and capabilities) necessary for DT, and the role of knowledge in this context. These analyses can help researchers to better delineate their research questions. Furthermore, considering the capabilities and resources presented, companies can direct their efforts to implement new, more effective KM processes to deal with this new scenario.

The main limitation of this research was the choice of databases to select the initial articles. Although three of the main databases were used, it cannot be assumed that valuable research on the subject has not been published elsewhere.

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